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THE IDENTIFICATION OF TRUE MAHOGANY, CERTAIN SO-CALLED MAHOGANIES, AND SOME COMMON SUBSTITUTES.

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"MAHOGANIES."

Over sixty different species of timber have at one time or another been put on the market under the name of mahogany. Some of these are closely related botanically to true mahogany and others look much like it, while some have only the most general resemblance, and no relationship which under the most liberal interpretation would entitle them to the name.

The woods now most commonly sold as mahogany in this country are true mahogany from tropical America, "African mahogany," and "Philippine mahogany." The Cedrelas (Spanish cedar, etc.) are rarely sold as mahoganies, while crabwood, sapeli, "Colombian mahogany," and "Liberville mahogany" are imported only in small quantities. They are, however, described in this bulletin because of their resemblance to true mahogany. A description of "white mahogany" is also included, for though it has no reddish-brown color and so is not confused with true mahogany by anyone who has seen a few pieces, the name might lead one unfamiliar with it to assume that it is true mahogany of a light color. Birch and red gum are

used principally as acknowledged imitations of mahogany, but sometimes they are used in furniture sold as genuine mahogany.

Of the woods mentioned in this bulletin, true mahogany, crabwood, the Cedrelas, sapeli, and "African mahogany" come from trees which are botanically of the mahogany family (Meliaceæ). They are uniformly distinguished from other woods herein described by the occurrence of a dark reddish-brown gum in the pores. This gum does not completely fill the pores, but occurs as almost black masses here and there. It is seen best with a magnifying glass on longitudinal surfaces, but in many specimens is visible without a lens. Of course, woods of other families may have dark gum in the pores, but none such are commonly substituted for mahogany.[1]

KEY FOR THE IDENTIFICATION OF TRUE MAHOGANY AND MAHOGANYLIKE WOODS.[2]

(Also read carefully the descriptions of these species in the following pages and study the illustrations.)

I. Wood light to dark reddish brown.

A. Many pores contain more or less of a very dark reddish brown gum visible on longitudinal and end surfaces. Otherwise the pores are open, no tyloses being present. The gum is visible without, but better with a hand lens.

1. Growth rings sharply but not always conspicuously defined.

AA. Wood without characteristic odor. Growth rings defined by distinct but not always conspicuous lines of soft tissue $\frac{1}{32}$ to ½ inch apart. Pores in each growth ring almost uniform in size.

a. Lines of soft tissue light-colored and conspicuous. Rays on a freshly cut or split radial surface not much darker than adjacent fibers. *Tangential* surface occasionally but not always figured with very fine bands which run across the grain, due to the rays being in stories. Wood highly variable in weight and light to dark reddish brown in color. True mahogany ..... (*Swietenia* spp.).

b. Lines of soft tissue mostly dark, not conspicuous. Rays on a freshly cut or split radial surface considerably darker and more reddish than adjacent fibers and usually with a slight purplish tinge. Rays not in stories. Wood moderately hard. Color more of a plain brown than in true mahogany. Crabwood ..... (*Carapa guianensis*).

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[1] To one familiar with the examination of wood sections under a high-power microscope, the exceedingly fine pits (as small as in birch) between adjacent vessels and also the septate wood fibers found in *Swietenia, Carapa, Entandrophragma,* and *Khaya* offer an additional means of distinguishing these members of the mahogany family from others not of the same family. In Cedrela the pits are larger, but also very numerous, and the wood fibers are sparingly septate. *Boswellia* (family Burseraceæ) also has septate wood fibers, but the pits in the vessel walls are comparatively large.

[2] Unless otherwise directed all observations as to structure should be made on the end surface cut smoothly with a very sharp knife, and all observations as to color should be made on freshly cut longitudinal surfaces of the heartwood.

I. Wood light to dark reddish brown—Continued.
A. Many pores contain, etc.—Continued.
1. Growth rings, etc.—Continued.
BB. Wood with characteristic odor of cigar-box cedar. Growth rings defined by distinct lighter-colored lines and usually, but not always, by rows of larger pores, approaching ring-porous structure as in ash, oak, hickory, and some other hardwoods. Wood light and soft.
Spanish cedar ---------- (*Cedrela odorata*).
Brazilian cedar ---------- (*Cedrela braziliensis*).
Toon ---------- (*Cedrela toona*).
(Odor most pronounced in Spanish cedar.)
2. Growth rings not clearly defined by lighter colored lines or otherwise.
AA. Numerous tangential lines of soft tissue either lighter or darker colored than the adjacent fibers and readily visible without a lens—40 to 50 per inch of radius. Rays usually not in stories and white substance not found in pores. Wood moderately heavy.
Sapeli ---------- (*Entandrophragma candollei*).
BB. Tangential lines of soft tissue either not present or very rarely an occasional one; however, darker or lighter colored zones without definite boundary, as seen under a hand lens, may be present. Color same as true mahogany, or quite often with a slight purplish tinge when freshly cut. Rays not in stories, or only locally, and white substance not found in pores as in some true mahogany. Wood moderately heavy.
"African mahogany" ---------- (*Khaya* spp.).
B. Pores do not contain a reddish gum.
1. Pores readily visible without a lens on smoothly cut surfaces.
AA. Occasional short or long white tangential lines present, from ⅛ inch to several inches apart radially, visible without a lens. When viewed with a magnifying glass these lines appear to be made up of a row of small ducts, much smaller than the pores, and completely filled with a white substance. Considerable variation in color. Weight variable, about the same as mahogany.
"Philippine mahogany" ---------- (*Shorea* spp.).
a. Color moderately light to dark reddish brown, with purplish tinge. Pores comparatively small but visible without a lens. Pinworm holes rare.
Tanguile ---------- (*Shorea polysperma*).
b. Color dark reddish brown without purplish tinge. Pores slightly larger than in tanguile. Pinworm holes common.
Red lauaan ---------- (*Shorea negrosensis*).
c. Color very pale reddish brown without purplish tinge. Pores slightly larger than in tanguile. Pinworm holes rare.[3]
Almon ---------- (*Shorea eximia*).

[3] On account of variations in the structure and color of tanguile, red lauaan, and almon, it is not always possible to distinguish the wood of these species by means of the characteristics given in this key, which is based on typical features.

I. Wood light to dark reddish brown—Continued.
B. Pores do not contain a reddish gum—Continued.
1. Pores readily visible, etc.—Continued.
BB. No white tangential lines consisting of rows of ducts, but numerous very fine continuous lighter-colored lines of soft tissue present, 120 to 175 per inch of radius, barely visible without a magnifying glass. Wood moderately heavy.
"Colombian mahogany"----------(*Cariniana pyriformis*).
CC. No fine light-colored tangential lines present; structure very homogeneous. Color light purplish brown. Wood moderately light and soft.
"Liberville mahogany"----------(*Boswellia klaincana*).
2. Pores not readily visible without a lens.
AA. Pores barely visible without a lens on smoothly cut surfaces in good light; very distinct under a lens. The heartwood is dull reddish brown; the wide sapwood is white. The wood is heavy, usually straight-grained.
Sweet birch----------(*Betula lenta*).
Yellow birch----------(*Betula lutea*).
BB. Pores not visible without a lens; very small and uniformly distributed as seen with a lens. The heartwood is reddish brown, often with darker streaks; the wide sapwood is pinkish white (unless blued by stain). The wood is moderately heavy and usually has interlocked grain.
Red gum----------(*Liquidambar styraciflua*).

II. Wood without reddish tinge. Color creamy white to yellowish brown. Growth rings sharply but not conspicuously defined by white tangential lines or by a slightly darker band of summerwood. Pores of practically uniform size throughout growth ring, barely visible on a smoothly cut end surface, but very distinct as fine grooves on planed longitudinal surfaces; mostly filled with tyloses. Wood with interlocked grain and moderately heavy.
"White mahogany," or primavera----------(*Tabebuia donnell-smithii*).

NOTE.—The sapwood of birch is without reddish tinge, and when taken by itself might be classified under "II" above, although fresh cuts are almost white. For means of distinguishing birch from primavera, see descriptions of these species.

DESCRIPTION OF SPECIES.

TRUE MAHOGANY.[4]

Swietenia mahagoni Jacq.[5]; *Swietenia macrophylla* King.; *Swietenia cirrhata* Blake; *Swietenia humilis* Zucco.; *Swietenia candollei* Pittier.

MAHOGANY FAMILY (MELIACEÆ).

OTHER NAMES.

True mahogany comprises all the species of the botanical genus *Swietenia*, of which five are known at present.[6]

[4] See U. S. Dept. Agr. Bulletin 474, "True Mahogany," by C. D. Mell. For sale by Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 5 cents.

[5] The name after a scientific name is usually an abbreviation of the name of the person who first described the species.

[6] Blake, S. F., "Revision of the True Mahoganies." Journal of the Washington Academy of Sciences, vol. 10, pp. 286–297, f. 1–2.

Mahogany is rarely sold under any other trade name, except that the very light grades are called "bay mahogany" or "bay wood." The Spanish name is "caoba" and in Florida it is called "maderia." *Swietenia cirrhata* is known locally as "venadillo."

Occasionally the name mahogany is modified so as to indicate the country it came from, as Honduras mahogany, Tabasco mahogany, Cuban mahogany, etc.

WHERE GROWN.

True mahogany grows in tropical America from southern Florida and northern Mexico to northern South America, including the West Indies. It does not grow naturally in Brazil or other parts of the world. According to Blake,[6] *Swietenia mahagoni* grows in the West Indies, Bermuda, and the keys of southern Florida; *S. macrophylla* grows along the eastern coast from the State of Tabasco, Mexico, to Honduras and possibly farther south; *S. humilis* is a native tree of the west coast from Guerrero, Mexico, to northwestern Guatemala; *S. cirrhata* is known to occur naturally in western Mexico from Sinaloa to El Salvador; and *S. candollei* is a native of Venezuela. Of the five species, *Swietenia mahagoni* and *S. macrophylla* are the more common. *Swietenia macrophylla*, which has larger leaves and larger fruit than the West Indian species, grows principally on low lands, and, as a rule, produces softer and lighter colored wood than *S. mahagoni;* however, no distinct differences in the wood by means of which each species can be identified have so far been observed.

PHYSICAL PROPERTIES.

The wood of true mahogany is highly variable in weight; pieces ranging in specific gravity from 0.34 to 0.90, based on oven-dry weight and oven-dry volume, have been found, although very few pieces have a specific gravity greater than 0.70. The wood from southern Florida and Cuba averages heavier than that from Central America.

The color of true mahogany varies from very pale to very dark reddish-brown. The wood is without characteristic odor or taste. True mahogany usually has interlocked grain, which gives the "ribbon" effect to quarter-sawed material. Unlike most other woods with interlocked grain, it does not warp easily.

STRUCTURE.

The pores in true mahogany are plainly visible without a hand lens as minute holes on a smoothly cut end surface (see fig. 1) and as grooves on longitudinal surfaces. They are scattered singly or in short radial rows of 2 to 4. Some of the pores are filled with a dark

[6] Blake, S. F., "Revision of the True Mahoganies." Journal of the Washington Academy of Sciences, vol. 10, pp. 286–297, f. 1–2.

brown gum, but less plentifully in the light-colored, soft grades than in the darker grades. In heavy grades some pores also contain a whitish substance. (See fig. 1.[7]) These pores differ from the white gum ducts in "Philippine mahogany" in being scattered singly instead of in tangential rows; furthermore, the gum ducts in "Philippine mahogany" are smaller than the sap pores.

The rays on the radial surface are very distinct. On account of the luster of both rays and wood fibers, the rays may appear lighter or darker than the surrounding areas, depending on how the light is reflected. Actually the rays are only slightly, if any, darker than the surrounding fibers, a characteristic which helps to distinguish mahogany from crabwood, in which the rays are considerably darker. In some pieces of mahogany the rays are in rows or stories extending at right angles to the grain—that is, horizontally in the tree—showing up on the tangential surface as striations, or "ripple" marks, across the grain. (See fig. 12.) This condition of the rays being in stories is not always found in true mahogany, but is rarely found in any of the other species herein described, although it is common in a number of other woods not mentioned in this publication.

The growth rings in true mahogany are defined by light-colored concentric lines, in some pieces very close together and in others one half inch or more apart, with considerable variation in the same piece.

CRABWOOD.

(*Carapa guianensis* Aubl.)

MAHOGANY FAMILY (MELIACEÆ).

OTHER NAMES.

This wood is known as "Para mahogany," "Brazilian mahogany," "Demerara mahogany," "British Guiana mahogany," and in South America as "andiroba."

WHERE GROWN.

Crabwood grows in northern South America as far south as the Amazon Valley, although the exact limits of its geographical distribution are not known. It is a common timber tree of British Guiana.

PHYSICAL PROPERTIES.

The wood is moderately heavy and hard, and similar to magohany, except that such extremes of very light and very heavy grades are not found.

The color is similar to that of true mahogany, except that it is not quite so reddish, but rather more of a plain brown.

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[7] The text figures will be found grouped at the end of this bulletin.

The grain is straighter than in mahogany, but the wood is said to check and warp more easily in seasoning; however, the Forest Service has no authentic information on its seasoning qualities.

STRUCTURE.

The pores are plainly visible on smoothly cut transverse and longitudinal surfaces. They are fairly uniform in size and evenly distributed, and in all respects closely similar to those of true mahogany, but somewhat smaller than in "African mahogany." Hardened masses of dark-brown gum are visible here and there in the pores. These can best be seen with a hand lens on longitudinal surfaces. No whitish deposits in the pores of this wood have been noticed by the author, although Dixon[8] reports their occurrence. (See fig. 2.)

The rays are very fine on cross-section, but quite conspicuous on radial surfaces, owing to the fact that they contain reddish coloring matter. (See fig. 13.) This reddish color of the rays is one of the chief means of distinguishing crabwood from true mahogany, although the rays in mahogany may appear darker if the light is reflected in a certain manner. All "Philippine mahogany" and occasional pieces of "African mahogany" may also have reddish rays, but can be distinguished from crabwood by other means. (See key.)

The growth rings, which are very irregular in width, are faintly defined by somewhat lighter colored lines of soft tissue similar to but much less conspicuous than those in mahogany.

CEDRELA.

Spanish Cedar (*Cedrela odorata* L.); Brazilian Cedar (*Cedrela braziliensis* Juss.); Toon (*Cedrela toona* Roxb. or *Toona ciliata* Roem. or *Toona toona* Wight.).

MAHOGANY FAMILY (MELIACEÆ).

OTHER NAMES.

Spanish cedar[9] is also commonly known as "cigar-box cedar."

Brazilian cedar[9] is known in South America as "cedro."

Toon has been marketed as "Indian mahogany" and "toona mahogany."

The Spanish and Brazilian cedars are rarely sold as mahogany, but because of their resemblance to the light grades of true mahogany their description is included here.

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[8] Dixon, H. H., "Mahogany, and the Recognition of Some of the Different Kinds by Their Microscopic Characteristics." Scientific Proceedings of the Royal Dublin Society, Vol. XV (N. S.), No. 34, Dec., 1918.

[9] These species are not true cedars. They belong to the hardwood class, that is, trees with broad leaves, but were probably given the name of cedar because of the aromatic odor of the wood.

WHERE GROWN.

The true Spanish cedar (*Cedrela odorata* L.) is not definitely known outside of the West Indies and French Guiana.

Brazilian cedar grows in Brazil and northern Argentina. A number of minor species of Cedrela are also found in Mexico, Central America, and South America.

Toon is a native of India, Java, and Australia, and is shipped to the United States in comparatively small quantities. A similar species, calantas (*Toona calantas* Merr. and Rolfe), is of commercial importance in the Philippine Islands.

PHYSICAL PROPERTIES.

The color of these woods is very much like that of true mahogany. In weight they are lighter than the average mahogany. They have a distinct, pleasant odor, most pronounced in Spanish cedar. The grain of the wood is not interlocked so much as in mahogany.

STRUCTURE.

The pores of the Cedrelas are plainly visible with the unaided eye. (See fig. 3.) Some of the pores are partly filled with a dark reddish-brown gum, a characteristic of the mahogany family. As a rule, but not always, the pores are slightly larger at the beginning of each growth ring, making the wood "ring-porous." The growth rings are also defined by a light-colored line of soft tissue, as in true mahogany. This line is not so conspicuous in toon as in the two species from the American Tropics.

The rays are very fine, being barely visible with the unaided eye on a smoothly cut end surface. On radial surfaces they are very lustrous and appear lighter or darker than the surrounding fibers, depending on how they reflect the light. These rays are never storied, as in some pieces of mahogany.

SAPELI.[10]

Entandrophragma candollei Harms.

MAHOGANY FAMILY (MELIACEÆ).

OTHER NAME.

"African mahogany."

Other species of Entandrophragma, with similar characteristics, may also be included with sapeli. *Entandrophragma candollei* is known as "unscented mahogany," and *E. utilis* as "scented mahogany."[11]

[10] Also spelled "sapele;" in either case pronounced sap'-el-e.

[11] Unwin, A. Harold, "West African Forests and Forestry." T. Fisher Unwin, publisher, London, 1920.

WHERE GROWN.

Countries bordering on the Gulf of Guinea, west coast of Africa.

PHYSICAL PROPERTIES.

The wood is considerably heavier than that of the Khayas. The grain may be very much interlocked, but no information as to whether the wood warps easily is available. No pronounced odor or taste is present in the wood, although a slight odor, faintly resembling that of Spanish cedar, is noticeable in some pieces.

STRUCTURE.

The pores are visible without magnification on smoothly cut end and longitudinal surfaces. They are fairly uniform in size, evenly distributed, singly or often in twos, and occasionally in threes. As in other species of the mahogany family, the pores contain more or less of a dark reddish-brown gum.

The chief characteristic of sapeli is the presence of numerous tangential lines of soft tissue seen on a smoothly cut end section of the wood. (See fig. 4.) These lines are usually darker, but may be lighter, than the other portion of the wood and average 40 to 50 to the radial inch. The constant closeness of these lines eliminates the possibility of mistaking them for lines limiting growth rings, as in true mahogany. Seasonal growth rings are not clearly defined. According to Record,[12] the rays are more or less storied as seen on the tangential faces, but this was not the case in the specimens available to the writer.

"AFRICAN MAHOGANY."

(*Khaya* spp.)

MAHOGANY FAMILY (MELIACEÆ).

OTHER NAMES.

Several species of the genus Khaya are marketed as African mahogany.[13] Probably the most common one is *Khaya senegalensis* A. Juss. Other names applied to these species are "Senegal mahogany," "Gambia mahogany," "Benin mahogany," and "Gaboon mahogany," indicating the regions from which the species are obtained.

Other species, as sapeli, and some not of the mahogany family, are occasionally called "African mahogany," but very little wood of these species is brought into the United States.

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[12] Record, S. J., "Mahogany and Some of Its Substitutes." Journal of Forestry, Vol. XVII, No. 1, Jan., 1919.

[13] For detailed information concerning the various species of Khaya see Unwin, Harold A., "West African Forests and Forestry."

WHERE GROWN.

West coast of Africa and inland along a belt from 15° north to 20° south of the Equator, and found occasionally in Uganda and Mozambique on the east coast.

PHYSICAL PROPERTIES.

African mahogany is similar to true mahogany in its properties, except that it does not show such extremes of density and color. Occasional boards have a purplish tinge mixed with the usual reddish-brown color.

Interlocked grain is usually present, but, as in true mahogany, is not associated with excessive warping.

STRUCTURE.

The pores are plainly visible without a lens; in fact, they are slightly larger than in true mahogany, giving the wood a coarser texture. They are fairly uniform in size and evenly distributed. (See fig. 5.) Abundant dark reddish-brown gum is found in most of the pores.

No distinct growth rings are present. Lighter and darker concentric zones are often found, but without a sharp line of demarcation. The absence of the fine tangential lines limiting growth rings in true mahogany of tropical America is the chief feature of distinction between these two woods. The author has noticed one or two such lines in certain pieces of "African mahogany," but not many, as is usual in true mahogany. Care must be taken not to mistake knife marks for such fine lines.

The rays are barely visible without a lens on a smoothly cut end surface, but are very plain and lustrous on radial surfaces. They are never conspicuously storied on the tangential faces, as in true mahogany, although they may be in irregular stories locally.

"PHILIPPINE MAHOGANY."[14]

Tanguile[15] (*Shorea polysperma* Merr.); Red lauaan[16] (*Shorea negrosensis* Foxw.); Almon (*Shorea eximia* Scheff.).

LAUAAN OR DIPTEROCARP FAMILY (DIPTEROCARPACEÆ).

OTHER NAMES.

Tanguile is also known as "Bataan mahogany" and "tanguile mahogany." The heavier grades of red lauaan are substituted for tan-

[14] See Philippine Bureau of Forestry Bulletin 14, "Commercial Woods of the Philippines: Their Preparation and Uses," by E. E. Schneider. Bureau of Printing, Manila, P. I. Price, $1.

[15] Also spelled "tangil." Pronounced tang-he'-le.

[16] Pronounced lau-ah-an'.

guile on the Manila market. Almon has no other common names except in the native dialect.

Tanguile and red lauaan constitute the bulk of so-called "Philippine mahogany" sent to the United States. Almon is included occasionally. Rarely, other species of the Dipterocarp family may be included, especially white lauaan (*Pentacme contorta* Merr. and Rolfe) and bagtican (*Parashorea malaanonan* (Blanco) Merr.). When tanguile is desired, *genuine tanguile* should be specified.

WHERE GROWN.

Philippine Islands.

PHYSICAL PROPERTIES.

Tanguile is "soft to moderately hard; light to moderately heavy, specific gravity 0.469 to 0.509 (Gardner);[17] heartwood pale red to dark reddish-brown; grain distinctly crossed, producing a broad, conspicuous ribbon when quarter-sawed; seasons well, but may warp if not carefully stacked; easy to work."[18]

Red lauaan is "soft to moderately hard; light to moderately heavy, specific gravity 0.406 (Gardner); heartwood light red to dark reddish brown; grain distinctly crossed, forming a conspicuous ribbon when quarter-sawed; texture rather coarse; seasons well, splitting and warping very little; easy to work."[18]

Almon is "soft; light, specific gravity 4.464 (Gardner); heartwood very pale red; texture rather coarse; grain somewhat crossed, making a narrow distinct ribbon when quarter-sawed, small but distinct silver grain; seasons well, checking and warping very little; very easy to work."[18]

Tanguile, in general, is slightly heavier, harder, stronger, and finer-grained than either red lauaan or almon.

STRUCTURE.

The pores are very distinct on smoothly cut transverse and longitudinal surfaces. They are fairly uniform in size in each species, but average slightly smaller in tanguile than in red lauaan and almon. They are evenly distributed, singly or occasionally by twos. The pores are open for the most part, but occasionally contain tyloses. Reddish-brown gum is never found in the pores.

White tangential lines varying in length from very short to the full thickness of a board are usually common on the cross-section (see

[17] The moisture percentage and the volume (oven-dry or otherwise) on which this specific gravity is based are not given, but undoubtedly the basis of computation was the same as that used in computing the specific gravities of red lauaan and almon quoted in the succeeding paragraphs. Forest Products Laboratory determinations show an average specific gravity for tanguile based on the oven-dry weight and oven-dry volume of 0.57.

[18] Philippine Bureau of Forestry Bulletin 14, pp. 168–171.

fig. 6), but may be absent for areas of several square inches. Under a magnifying glass it can be seen that these white lines are made up of rows of ducts (smaller than the pores) containing a white gum, differing in this respect and in not being continuous from the light-colored lines found in true mahogany. These tangential rows of white gum ducts are found in no other species sold as mahogany, unless it be in other species of the Dipterocarp family which may occasionally be included in shipments of "Philippine mahogany."

Short lines of lighter colored tissue extending for a short distance tangentially from the pores may occasionally be seen with a lens on smoothly cut end surfaces. It is not necessary to look for these, however, in distinguishing "Philippine mahogany" from other species herein described.

The rays are not visible without lens on an end section, but are very conspicuous on radial surfaces because of their reddish color.

No well-defined growth rings are present, although the rows of gum ducts when long might be mistaken for the termination of seasonal layers.

"COLOMBIAN MAHOGANY."[20]

(*Cariniana pyriformis* Miers.)

MONKEY-POD FAMILY (LECYTHIDACEÆ.)

OTHER NAMES.

Cariniana, albarco (Colombia).

WHERE GROWN.

Colombia, South America.

PHYSICAL PROPERTIES.

The wood has about the same weight and color as moderately heavy mahogany, except that a slight purplish tinge is usually present. It has more or less interlocked grain, but is said not to give any trouble by warping when properly seasoned.

STRUCTURE.

The pores are visible without a lens on smoothly cut end and longitudinal surfaces. They are fairly uniform in size, and evenly scattered, singly or occasionally by twos. They do not contain brownish gum, as do those in true mahogany, but contain some tyloses. The growth rings are very faintly defined by a slight difference in the size of the pores.

[20] See Forest Service Circular 185, "Colombian Mahogany," by Geo. B. Sudworth and C. D. Mell. Government Printing Office, Washington, D. C. Price, 5 cents.

A striking characteristic of the wood is the presence of very numerous, fine, lighter colored, tangential lines of soft tissue, barely visible without a lens. These lines are fairly evenly spaced and average from 120 to 175 per inch of radius. (See fig. 7.) Similar lines, but wider apart, are found in sapeli, and the presence in "Colombian mahogany" of tyloses instead of gum is an additional aid in distinguishing the two species.

The rays are not distinctly visible on cross sections, but on radial surfaces are very distinct because of their reddish-brown color.

"LIBERVILLE MAHOGANY."

(*Boswellia klaineana* Pierre.)

MYRRH FAMILY (BURSERACEÆ).

OTHER NAMES.

Gaboon mahogany; okume; okoumie; African cedar.

WHERE GROWN.

French Kongo and adjacent territory of Africa.

PHYSICAL PROPERTIES.

The wood is lighter and softer than the average genuine mahogany, although it is firm enough to be used for furniture and similar articles. It is pale pinkish-brown or pale flesh-colored with a faint lavender tinge. Dressed surfaces appear lustrous. The wood is without characteristic odor or taste.

The grain runs straighter than in mahogany, and hence the "ribbon" effect is not so pronounced in quarter-sawed lumber.

STRUCTURE.

The pores are very distinct to the unaided eye, being of about the same size as those in true mahogany. They are scattered singly, or occasionally several in short radial rows. The pores are empty, except for occasional tyloses.

Tangential lines of light-colored tissue are absent, although poorly defined tangential zones of darker and lighter wood may occasionally be present. (See fig. 8.)

The rays are very fine, not visible on a cross-section without a hand lens.[21] On radial surfaces they are distinct but comparatively small, and not much darker than the surrounding wood.

[21] "Liberville mahogany" and "Colombian mahogany" are the only species herein described in which the rays are characteristically 2 (occasionally 1 or 3) cells wide, as seen with a high-power microscope on the tangential section. In all the other species the larger rays are 4 or more cells wide, except in some pieces of red gum in which the rays are mostly 2 or 3 cells wide.

BIRCH.

Sweet birch (*Betula lenta* Linn.); yellow birch (*Betula lutea* Michx. f.).

BIRCH FAMILY (BETULACEÆ).

OTHER NAMES.

Sweet birch is also known as cherry birch, black birch, and mahogany birch.

Yellow birch is also known as gray birch, silver birch, and swamp birch.

The heartwood of both species is usually sold as "red birch" and the sapwood as "yellow birch."

Other species of birch are rarely cut into lumber.

WHERE GROWN.

Sweet birch grows within an area that extends from Newfoundland to eastern Iowa, and south to northern Florida. It is of commercial importance, principally in the East, from New York State south along the Appalachian Mountains, although it is cut as far west as Wisconsin.

Yellow birch occurs from Newfoundland to northern Minnesota, and through the northern States to eastern Tennessee, North Carolina, and Delaware. It is most abundant and reaches its largest size in northern New England and New York and in northern Michigan and Wisconsin.

PHYSICAL PROPERTIES.

Although sweet birch averages slightly heavier and harder than yellow birch, the difference is so little that usually no distinction is made between the two species when used in the form of lumber. Both species are hard, heavy, and strong in bending.

Birch has somewhat of a tendency to warp, but not so much as red gum and other species with decidedly interlocked grain.

The heartwood is reddish brown; the sapwood, which is often wide, is practically white. Much sapwood is used in the manufacture of furniture with a mahogany finish. It is difficult to hide its identity since any wear or fracture is likely to disclose the white wood underneath the finish.

STRUCTURE.

The pores in birch are of such size that they can barely be seen in good light without a lens on the smoothly cut end surface. On the longitudinal dressed surface they appear as very fine grooves. They are almost uniform in size throughout each annual ring, although occasionally they are noticeably smaller toward the end of each year's growth. (See fig. 9.) The annual rings are defined by fine lines.

The rays are not distinctly visible without a lens on the cross-section. On radial surfaces they appear as fine reddish-brown "flakes."

RED GUM.

(*Liquidambar styraciflua* Linn.)

WITCH HAZEL FAMILY (HAMAMELIDACEÆ).

OTHER NAMES.

Sweet gum; star-leaved gum; hazel wood; satin walnut (Europe); sap gum (sapwood only).

WHERE GROWN.

In the United States south of a line from Connecticut through southern Illinois and Eastern Texas, except in southern Florida. It is very uncommon in the Southern Appalachian Mountains and the surrounding highlands, but is found on the mountains of Central and Southern Mexico and on the highlands of Guatemala. Most abundant commercially in the bottom lands of the lower Mississippi Valley.

PHYSICAL PROPERTIES.

The wood is moderately heavy and moderately hard. It usually has interlocked grain, which causes it to warp, especially when plain sawed, unless properly seasoned.

The heartwood is reddish-brown, varying more or less in shade. It often contains darker streaks which add to its beauty. The sapwood is pinkish white unless blued by stain. It is often wide and is sold separately as "sap gum."

STRUCTURE.

The pores are so small that they can not be seen without a good magnifying glass. (See fig. 10.) This feature distinguishes red gum from mahogany and mahogany-like woods. The pores are of uniform size and distribution throughout each annual ring, making it difficult to differentiate each year's growth, although on careful examination with a lens a fine line can be seen separating the annual growth layers.

The rays are fairly distinct, but not at all conspicuous without a lens on either an end or a radial surface, since they are relatively small and of about the same color as the surrounding wood.

Since the annual rings, pores, or rays do not stand out clearly, red gum has no characteristic figure except for the darker streaks in some grades.

"WHITE MAHOGANY."

(*Tabebuia donnell-smithii* Rose.)

TRUMPET-CREEPER OR CATALPA FAMILY (BIGNONIACEÆ).

OTHER NAMES.

Primavera. The names "jenicero" or "genesero" have also been applied to this wood, but these names are also used for an entirely different Mexican species, namely, guanacaste (*Enterolobium cyclocarpum*).

WHERE GROWN.

Western coast of Mexico and southward to Guatemala.

PHYSICAL PROPERTIES.

The wood is moderately heavy and hard, works well, and is said to give little trouble by warping. It is creamy white to yellowish-brown in color. The grain is interlocked, and the pores are of about the same size as in true mahogany, so that the figure produced, especially when finished with a mahogany stain, is similar to that of true mahogany.

STRUCTURE.

The pores are plainly visible on longitudinal surfaces as grooves, and can be seen on smoothly cut end surfaces as minute openings. They are arranged so as to form diagonal or wavy tangential rows, especially in the outer portion of each growth ring as seen on the cross-section. (See fig. 11.) Tyloses are very common in the pores. Fine tangential lines, often accompanied by a darker layer of summerwood, mark the limits of the growth rings. In some pieces the pores are also slightly larger at the beginning of each growth ring, making the rings more conspicuous.

The rays are barely visible on cross-section and inconspicuous on radial surfaces. On tangential faces they may or may not appear storied. When storied they never produce conspicuous "ripple" marks, as in true mahogany.

GLOSSARY.

Density.—Amount of wood substance, equivalent to oven-dry weight.

Ducts, or *gum ducts.*—Special ducts for storing or conveying gum. Found only in a few species of hardwoods; usually smaller and less numerous than the pores for conducting sap.

Family.—Botanically speaking, a group of plants having certain fundamental resemblances, especially in the flowers and fruit, yet differing more or less in this and other respects. For example,

apple, pear, and quince belong to one family, and walnut and hickory to another family.

Fibers.—The comparatively long thin cells usually comprising the bulk of the wood, but too small to be seen except with a high-powered microscope. Distinguished from the pores in the hardwoods, which are larger but less numerous.

Growth rings.—The well-defined layers of wood put on each season usually, but not necessarily, limited to one each year.

Gum.—A white or dark deposit, partly or wholly filling the sap pores or the gum ducts of certain woods.

Interlocked grain.—Fibers slanting around the tree in one direction for a number of years and then reversing to the other direction, and later reversing again, and so on, producing a "ribbon" effect on quarter-sawed lumber.

Light-colored lines.—Very thin light-colored lines extending circumferentially on the cross-section. These may mark the end of each growth ring, or many may be formed each season, as in sapeli and "Colombian mahogany." Composed of soft tissue technically known as parenchyma.

Longitudinal surfaces.—Either radial or tangential surfaces, as distinguished from cross-section, or end grain.

Pores.—Larger cells with open ends set one above the other, and used for conducting sap, as distinguished from the smaller wood fibers with closed ends used to give strength to the tree trunk. (True pores are not found in the coniferous woods, in which the fibers serve the combined purpose of conducting sap and giving strength to the tree.)

Radial.—Along the radius.

Radial surface.—A longitudinal surface cut approximately along the radius of the log, that is, from the bark toward the center; equivalent of edge grain or quarter-sawed surface.

Rays.—Rows of cells extending horizontally in a tree from the bank inwardly at right angles to the grain. Visible on strictly radial surfaces of all woods; very conspicuous in quartered oak. (See fig. 13.) On end surfaces they may be seen with a lens, or occasionally without, as fine radial lines crossing the growth rings.

Ring-porous.—Having the pores at the beginning of each growth ring comparatively large, with more or less abrupt decrease in size toward the outer portion of the growth ring.

Ripple marks.—Fine transverse markings uniformly spaced on the tangential faces of wood. (See fig. 12.)

Soft tissue.—Thin-walled cells, often in rows, usually producing lighter-colored lines when cut across the grain, used to store food. Technically called parenchyma.

Specific gravity.—The ratio of the weight of a piece of wood (or other substance), usually oven-dry, to the weight of an equal volume of water, with the latter considered as 1. (For most woods the specific gravity is less than 1, because they are lighter than water, which weighs nearly 62.5 pounds per cubic foot.)

Storied rays.—Rays arranged in horizontal layers or stories in the tree, producing "ripple" marks on tangential faces. (See fig. 12.)

Summerwood.—The outer, often darker and harder portion of each annual ring.

Tangential.—Along a tangent, or at right angles to the radius.

Tangential surface.—A longitudinal surface cut approximately at right angles to the rays, equivalent to flat grain or plain-sawed surface.

Tyloses.—Glistening, froth-like ingrowths in the pores of the heartwood, closing them up more or less.

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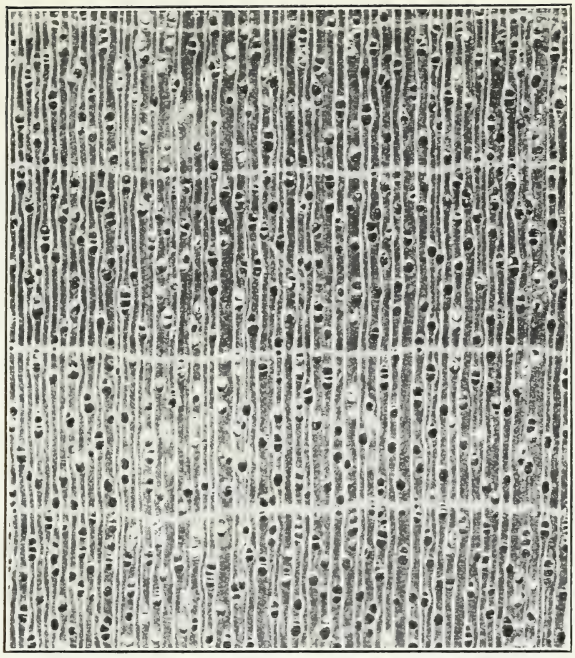

FIG. 1.—TRUE MAHOGANY. END GRAIN MAGNIFIED 7.5 DIAMETERS.

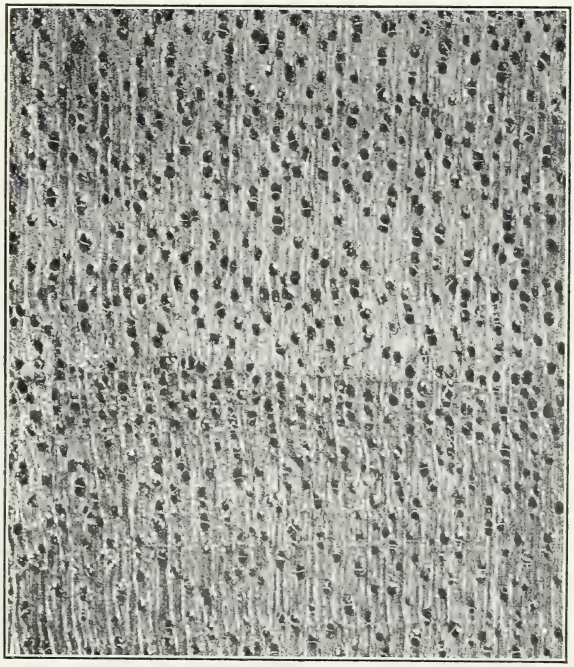

FIG. 2.—CRABWOOD. END GRAIN MAGNIFIED 7.5 DIAMETERS.

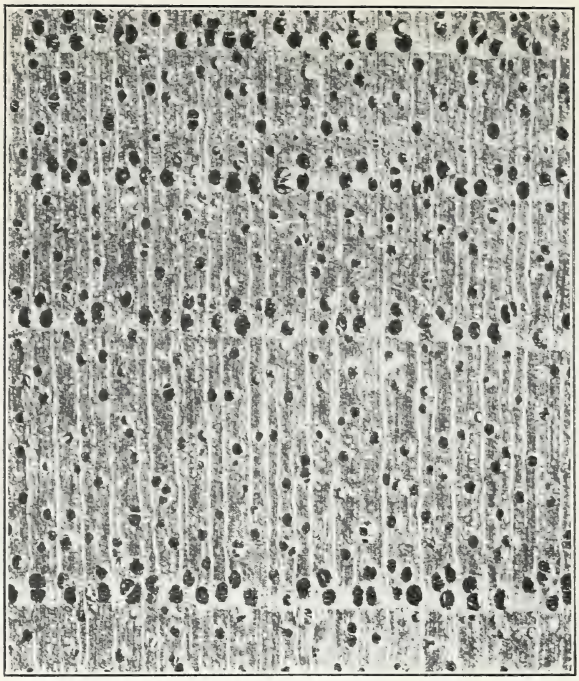

FIG. 3.—SPANISH CEDAR. END GRAIN MAGNIFIED 7.5 DIAMETERS.

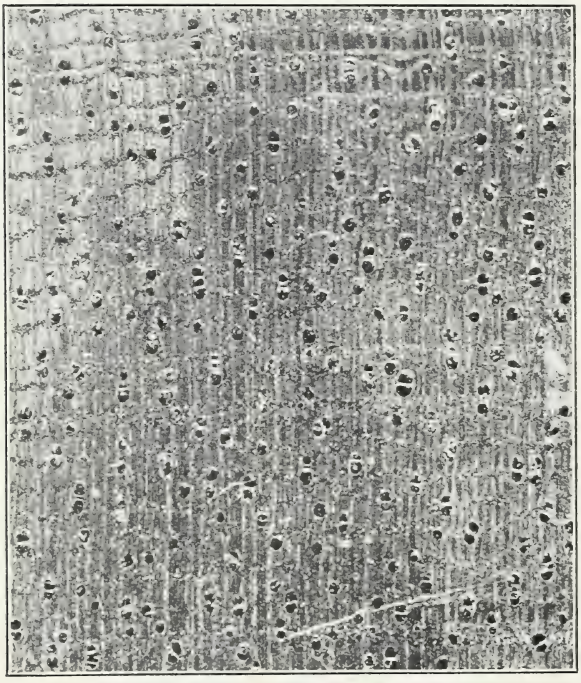

FIG. 4.—SAPELI. END GRAIN MAGNIFIED 7.5 DIAMETERS.

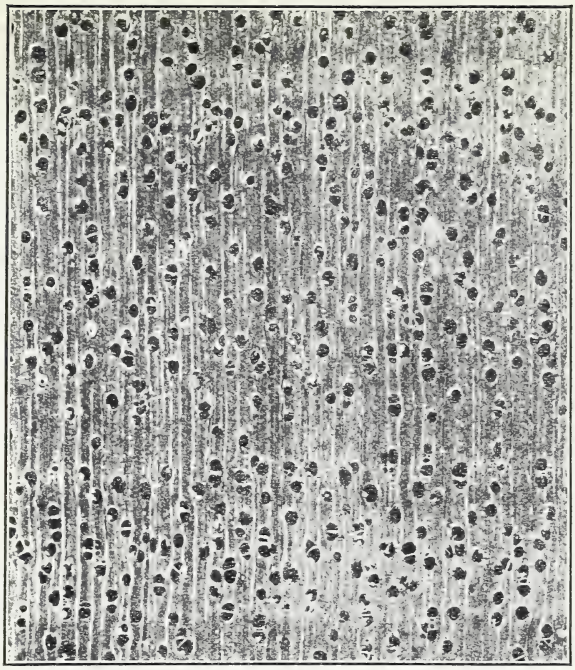

FIG. 5.—"AFRICAN MAHOGANY." END GRAIN MAGNIFIED 7.5 DIAMETERS.

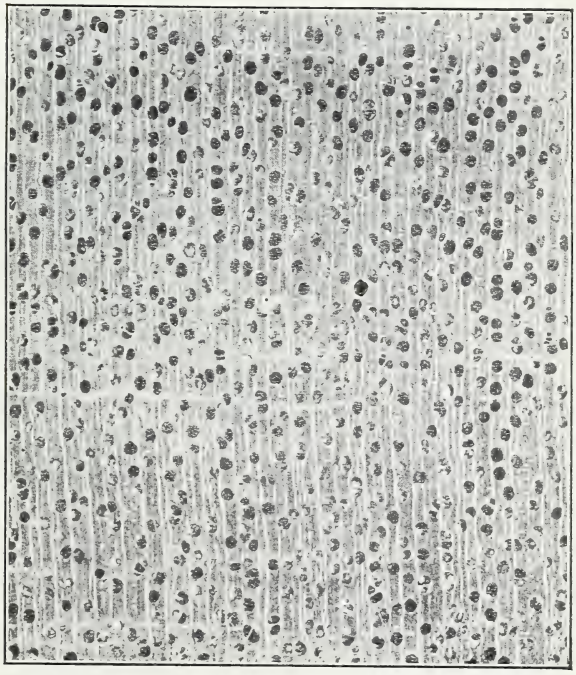

FIG. 6.—"PHILIPPINE MAHOGANY." END GRAIN MAGNIFIED 7.5 DIAMETERS.

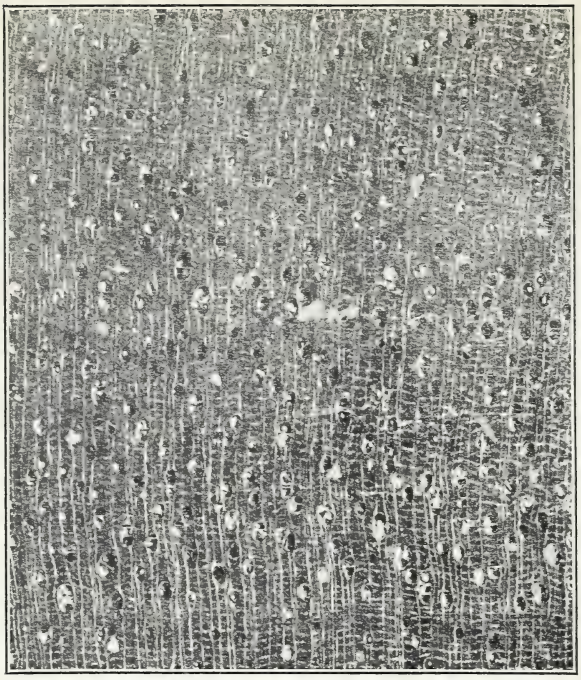

FIG. 7.—"COLOMBIAN MAHOGANY." END GRAIN MAGNIFIED 7.5 DIAMETERS.

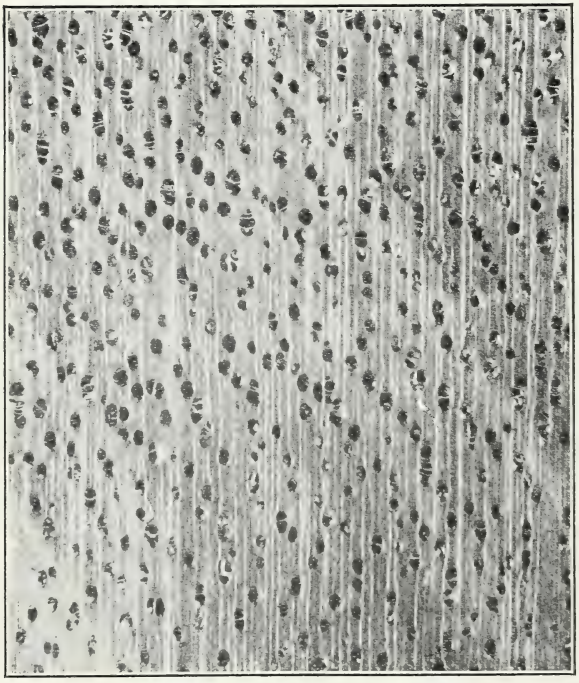

FIG. 8.—"LIBERVILLE MAHOGANY." END GRAIN MAGNIFIED 7.5 DIAMETERS.

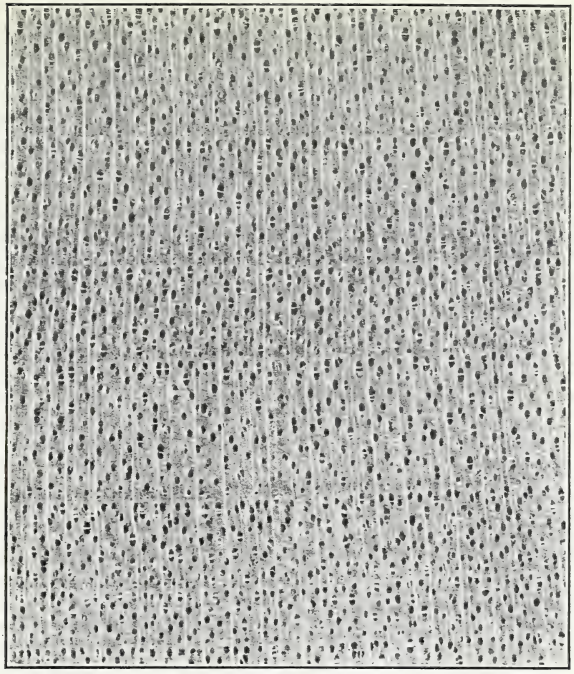

FIG. 9.—YELLOW BIRCH. END GRAIN MAGNIFIED 7.5 DIAMETERS.

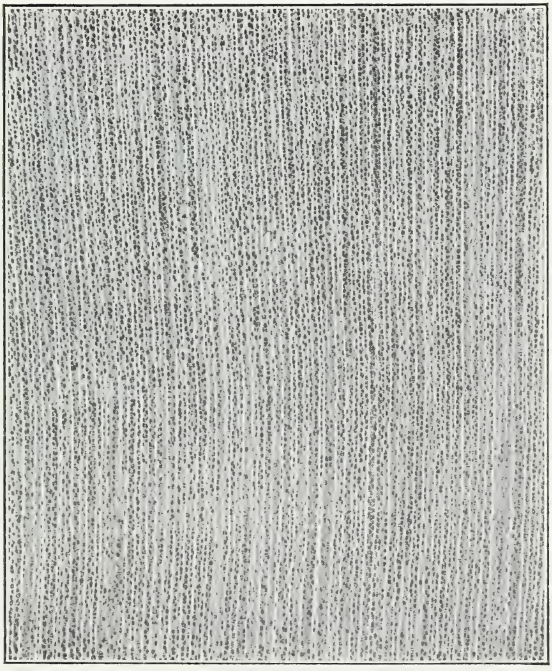

FIG. 10.—RED GUM. END GRAIN MAGNIFIED 7.5 DIAMETERS.

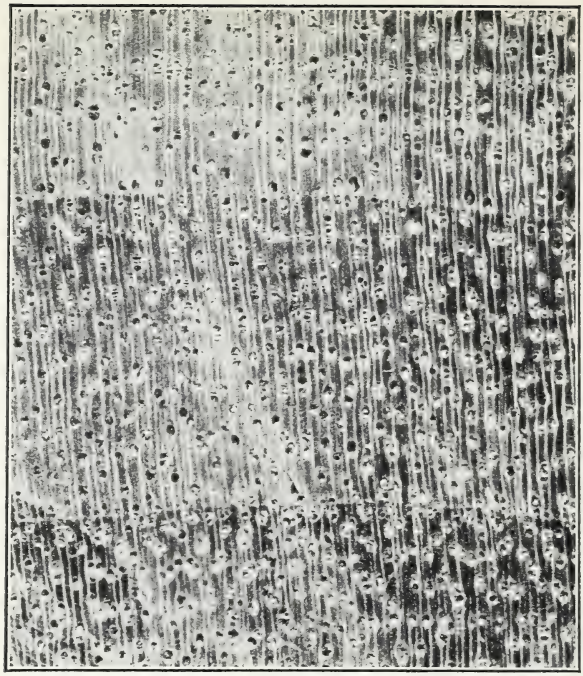

FIG. 11.—"WHITE MAHOGANY." END GRAIN MAGNIFIED 7.5 DIAMETERS.

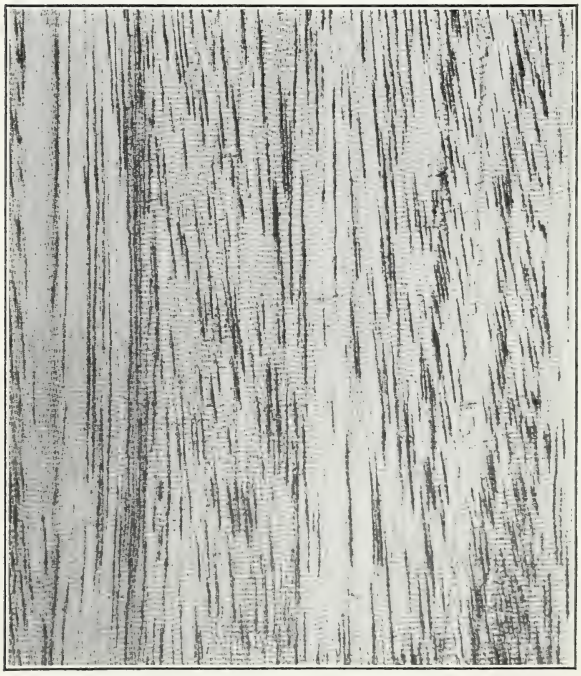

FIG. 12.—TANGENTIAL SURFACE OF TRUE MAHOGANY SHOWING THE RAYS MORE OR LESS IN HORIZONTAL ROWS OR STORIES.

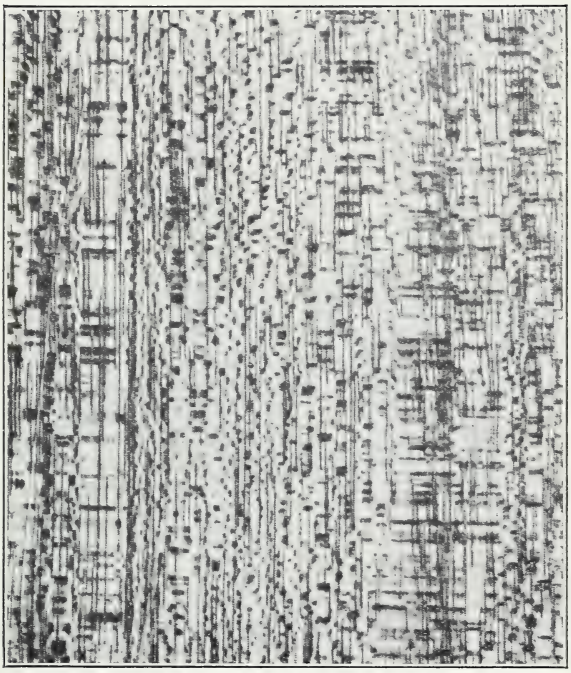

FIG. 13.—RADIAL SURFACE OF CRABWOOD SHOWING DARK RAYS.

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